January 1997 newsletter of the Human Ecology Action League - New York City Chapter. Reprinted by permission. 

## A COMPUTER IS NOT A FIT DOMICILE FOR MIDDLE-AGED LADIES AND OTHER LIVING THINGS

Well, they've gone and done it. They've made my City the equivalent of a Computerized Apple, and I can no longer live in it. Who woulda thunk?

On November 15, 1996 the gods of all that is righteous and good in wireless communications laid on Our Fair City a grid of radiation-emitting personal communications antennas. Lodged atop small buildings or perched at the third floor level of taller buildings and located every five or ten blocks, these antennas now criss-cross all five boroughs and much of the rest of this area, silently bombarding all of us with microwave radiation every step of our way. The purpose of this radioactive shower is better reception when we paste cellular phones to our ears to tell our live-ins and spouses which topping we prefer on our pizza delivery tonight.

I'd been feeling especially good in the months before the microwave incursion and was quite puzzled a few days before the 15th when I started feeling nauseous, unsteady and lightheaded in the streets. I didn't know what was hitting me and was desperately trying to deny that something was wrong. I never learn.

## THE RAT FLUNKS THE TEST

Only later did I figure it out. Apparently the communications company was field testing the system, and this sensitive laboratory mouse wasn't doing too well in the experiment. Then the company turned the system on full force. For several days I teetered symptomatically. I even dared to hope that I might escape the brunt of the ill effects, until—whammo—the microwave radiation hit me like a ton of —electromagnetic fields. Suddenly I felt as if I were living inside a computer. My thyroid swelled. My throat, neck and glands hurt like crazy. For a nanosecond I thought I could live with these symptoms. But, not so fast. Apparently this new antenna system had a bonus in store for me: a big, shiny, new EMF symptom I'd never experienced before: My insides now felt as if they were being raked up and down with an ice scraper every minute of the day. Clearly this was not going to be a radioactive picnic.

## THE RAT GETS KICKED OUT OF THE LAB

By the 19th of November my life had pretty much turned to the proverbial excrement. I knew I had to get out of the range of the damaging microwaves. Where to flee is always the question for the suddenly-made-homeless environmentally ill.

I'd recently tolerated 45 golden minutes at my 40th high school reunion in northern Connecticut, and had survived my first overnight in six years in my mom's liberally camphored, wall-to-wall carpeted, but welcoming apartment. If she would allow it, I would have to give her place a shot. I am a lucky daughter. She would, and I did.

## ON THE ROAD: MERRILY WE ROLL ALONG

Into shopping bag after shopping bag went a week's supply of tolerated groceries from Whole Foods. Into a new suitcase which I prayed I could tolerate went my pillow, my much-washed sheets, towel and blanket, a few tolerated pieces of clothing, shoes and boots. Into a spare Moishe's Moving carton went my typewriter, some files I was working on, envelopes, paper, blank file folders, stamps, a few books and magazines, and my Rolodex. Ready or not, I was New England-bound. My sainted brother-in-law found me a wonderful driver with car, since I can't tolerate trains, buses or planes and don't own my own wheels.

And so we set out, windows open in a torrential rainstorm, me in the back seat grinning maniacally as I endeavored to ignore the aromatic ghost of recently removed car air fresheners.

When we arrived, my son, who had made the trip with me, whipped out of his knapsack the greatest gift this refugee could have received: a Manhattan telephone book. I was launched. I just didn't know where I would land.

## DRIVING FOR DISTRACTION

To retain the rapidly depleting shards of my sanity, I had a goal for my Connecticut sojourn: I would get back my driving skills. Fortunately my mom's car is 20 years old, the perfect conveyance for a chemically and electrically sensitive canary. I'd always hated that car for its annoying habit, even in its youth of conking out on me as it rounded corners. I arrived on a Sunday. Bright and early Monday morning, I was behind the wheel, masking my

insecurity with a stream of nasty curses maligning the parentage of said vintage Pontiac. By Wednesday I was singing hosannas to the old gas guzzler, grateful that it had no computer whatsoever, and that it turned over like a dream ever morning on the open lot. By Friday, I was driving in a snowstorm, trying womanfully to forget the fact that I was rapidly reaching chemical overload, and would probably have to plan within days to flee somewhere else.

**(Editor's note:** Pelda and others are in need of MCS/ES suitable housing. If you have an extra room to rent or other accommodations, please let me know.)

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# ENDNOTES

• **Department of Energy EMF Conference**-During November, 1996 the annual U.S. Department of Energy's EMF conference convened in San Antonio, Texas. Presentations by scientists and medical doctors from the USA and many other countries centered on ELF (extremely low frequency) biological effects research categorized as follows: carcinogenesis, gene studies, neuroendocrine studies, mechanisms, dosimetry and exposure assessment, field management and public policy, and human studies and epidemiology.

In addition, eighty-eight poster presentations regarding these topics were on display. Although none of the formal presentations appear to be specifically about ES, three of the poster presentations highlighted ES. These were from (1) Dr. William Rea, Environmental Health Center, Dallas TX, (2) James Beal, EMF Interface Consulting, New Orleans LA, and (3) researchers at the National Institute for Working Life, Solna, Sweden.

Sweden's presentation is particularly important as it represents the results of a prospective study of 706 young, newly hired electrical utility workers. The study assessed nervous system symptoms over a nine-year period using an initial medical exam and questionnaire with 3-year follow-ups. Work tasks and field measurements were used to determine average electric and magnetic field exposures. Four hundred fifty-five male workers completed the nine-year study. Results after six years indicated that "neurasthenic" symptoms (per Soviets: generally fatigue, headaches, irritability, drowsiness, heart pain, etc.)[1] were higher in the group with the highest magnetic field exposure (greater than 12 milligauss). Dizziness correlated with electric field exposures of more than 30 Volts per meter for 2.5 minutes or more daily. At nine years, neurasthenic symptoms remained highest in the group most exposed to magnetic fields, with less exposed intermediate groups also developing an increase in these symptoms.

Soviet research in 1966 by Asanova found similar symptoms in 400-500kV hydroelectric workers: headache, fatigue, asthenia, drowsiness, tremors, hyperhidrosis, cardiovascular shifts, and dermographism.[2]

A summary of the 1996 US conference proceedings is available free from W/L Associates, Ltd., 7519 Ridge Rd., Frederick MD 21702-3519; Phone (301) 663-1915. Also, you may contact W/L Associates requesting to be added to their mailing list when the Call for Papers becomes available for presentation submissions in the next DOE EMF Conference, November 9-13, 1997, in San Diego, CA.

**Reference**

1. Petrov, I.R., ed. Influence of Microwave Radiation on the Organism of Man and Animals. VA: National Aeronautics and Space Administration, 1970.

2. Library of Congress. Washington, DC. (Aerospace Tech. Div.) Soviet Research on The Neural Effects of Microwaves. Washington DC: LOC, 1966, p. 24.

• **Tips on Cellular Antennas**-Wireless technology and its antennas are increasing at a rapid rate throughout the USA with no end in sight. At this time, it seems that the digital cellular technology is the most troublesome for the ES, particularly the GSM variety. The ES need to be heard via news media and your local members of Congress as soon as possible. The following tips may help: Contact your local EMF activist groups for assistance. Contact the EMR Alliance in New York for more regional EMF sources (Phone: (212)977-5541, Address: 410 W. 53rd St., Suite 402, New York NY 10019). Network with ES Network members, particularly regionally.

Also, contact your local city and county planning and zoning offices. Find someone there who will listen seriously to your concerns about the antennas—ask to talk with a planner. Explain that you are concerned about where the antennas may be placed in the future due to your health—explain about electrical sensitivity (ES). Ask them what regulations are in place now for antenna placements. Suggest that they need more information about ES and EMFs. Offer to drop by to talk with them and bring information they can review. Give the planning and zoning offices a letter with name, address, and phone number advising them that you want to be contacted regarding any future developments/hearings about antenna placements or about new antenna regulations, due to your medical condition. This letter

13. Barrie, Chris. "Cancer cases 'war chest'." Guardian, 12 Oct. 1996, p. 22 (England).

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## *News from the Cellular Phone Taskforce*

**Arthur Firstenberg - USA**



I have unfortunately been inundated with phone calls from all over the country about cellular phone antennas coming to where people live without their permission, with catastrophic effects on their health. Bronchitis, sinus problems, headaches, and insomnia are extremely common among the general population wherever these antennas go up. So is dryness of the mouth, eyes and skin. Many people are having eye problems, and some have gone blind. Radiation sickness is being misdiagnosed as flu, allergy, heart virus, food poisoning, and Lyme disease.

There have been an unknown number of deaths. One woman told me her father and her 3 dogs all died after a tower was turned on 50 feet from her house this winter. Those who read my press release of March 4, "Prevailing Scientific Opinion Collides With Reality", will remember Joe D. of the Bronx, a previously healthy 46-year-old man who began experiencing all of the symptoms of radiation sickness last November. He died May 8 of a brain hemorrhage. I have also received a report of a man in another state whose living room was directly above the microwave generating equipment for the antenna on the roof. He died of a brain hemorrhage 3 months after he moved in. **(Editor's note:** Merck Manual states that the most common cause of brain hemorrhage is high blood pressure. According to the Soviet research, during phase one of microwave sickness blood pressure rises.) I have received a report from a man who suddenly lost the vision in his right eye and had a sudden increase in his blood pressure soon after the activation of a PCS system in his area. A month later he suffered a non-fatal heart attack.

It is not just digital signals that are causing illness, and not just cellular technology either. Scanners (monitoring traffic and collecting tolls) are now blanketing toll roads with powerful radio signals, and I am beginning to hear from truckers who are apparently being affected by them. Scanners are also being used on railroad lines to keep track of individual railroad cars, and I have even seen what looked like a scanning tower sitting in the middle of a shopping center, who knows what for.

To deal with all this more effectively, the Cellular Phone Taskforce has organized as a not-for-profit corporation, and I have hired a lawyer, Curt Rogg-Meltzer, who at this time is researching 3 possible lawsuits. Their description, and a questionnaire, follow this report. At the moment I am paying all legal costs out of my own pocket, with the help of my family. These lawsuits could ultimately cost up to $100,000. Therefore I am asking for donations. Checks for this purpose should be made out to the Cellular Phone Taskforce, and will be put into an account reserved for this purpose. **(Editor's note:** I requested legal assistance for the ES from the American Civil Liberties Union (Arizona chapter), Sierra Club Legal Defense Fund, Trial Lawyers for Public Justice, and other similar organizations which provide free or low cost legal assistance, but was declined in every case.)

We are getting a lot more publicity for our cause now. WBAI radio in New York has been covering the issue regularly, and they have also been announcing meetings of the Taskforce. There was also a camera crew from Channel 9 news at the June 9 New York City public hearing on additional lamppost franchises. That story has not yet been broadcast, as of this writing. But, significantly, Suzanne Mattei of the Public Advocate's office was at the hearing advocating caution. She took the position that the Telecommunications Act does not require the City to rent out its lampposts, and that in any case an environmental impact study should have been done before the City contemplated placing telecommunications equipment on public property. The Franchise and Concession Review Committee—consisting of the Mayor, the 5 Borough Presidents, and 4 other officials—responded to the considerable public opposition at this hearing by tabling the vote until July 16.

Susan Clarke has been accomplishing miracles in Boston. Due to her efforts, almost the entire Departments of Environmental Health at the Harvard and Boston University Schools of Public Health signed a petition to suspend implementation of PCS (personal communications services) in Boston until there is full public notification of potential hazards, and review and determination of safety by the scientific community. Susan was also quoted in Peter Howe's news story on this issue which was published on June 16

in the Boston Globe, page B3, and she was interviewed on Channel 5 and Channel 38 in Boston, also on June 16.

There will also be national coverage for the first time in July. Look for my article in the upcoming Summer 1997 issue of Earth Island Journal.

The Taskforce is also launching its own newsletter, tentatively called "No Place To Hide", in July 1997. Its purpose will be to connect people and ideas about, and to facilitate action towards halting the expansion of wireless communications. The cost of a year's subscription is $20. Please address all correspondence to Arthur Firstenberg, Cellular Phone Taskforce, P.O. Box 100404, Brooklyn, NY 11210.

The following was submitted by my attorney, Curt Rogg-Meltzer. Please mail completed questionnaires to him at 516 Fifth Ave., 5th Floor, New York, NY 10036.

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This is a description of our three potential lawsuits:

We are in the process of researching and developing a suit against the FCC and possibly other government agencies to challenge the safety guidelines they have established as to the minimum levels of electromagnetic emissions that they deem safe for the public. We intend that the suit will be based on the Americans With Disabilities Act and Civil Rights Act in that the regulations discriminate against that segment of the population more sensitive to such effects, and discriminate against them by depriving them of their health and welfare. If we are successful in the suit, we have the potential to overturn or at least get the FCC to revise their national standards and to potentially void the issue of preemption of local concerns, which has also become a national issue.

The second suit that we are developing and researching will be for a group of plaintiffs and will be a straightforward personal injury suit against a specific telecommunications carrier(s) that we will have chosen. The critical component of that proposed litigation is the solid medical support establishing that the electromagnetic emissions have caused the injuries we will be claiming. If we are successful in establishing such a case, that will go a long way towards making it easier for any other injured parties to make similar claims throughout the country. Our goal in such a suit is to establish a blueprint as to how a plaintiff will be able to develop the proofs necessary to win in court (such as how to develop a record, how to establish the medical conditions they are claiming and how to overcome the "causation" hurdle that this type of litigation has a problem with).

The third suit that we are contemplating would be specifically to challenge the award of franchises to add hundreds of microwave antennas to lamp posts in New York City. The basis of that challenge would be whether or not proper procedures were followed, including but not limited to the absence of an environmental impact statement which the City has deemed not necessary in such circumstances. If we can establish that the Telecommunications Act does not preempt that issue and that such environmental impact statements are required, we can delay the implementation of this expansion of microwave antennas in New York City, require significant further medical and environmental studies be made by government, and indeed again provide a blueprint for other local communities to use as a basis for stopping the spread of this potential danger at this time.

We need to accumulate as much information as possible from all people claiming microwave and/or electromagnetic injuries and therefore, we ask that each such injured person fill out and return to us the following form:

1) The name, address and phone number that a person can be reached at who claims an injury,
2) the specific medical claims as to what is wrong, with as much detail as possible,
3) the date of the onset of such symptoms,
4) when and how the symptoms increased or decreased,
5) why the person claims the symptoms were caused by such microwave or electromagnetic transmissions (including the date of installation of new equipment, transmittal lines, etc.),
6) the name and address of the person where medical assistance was sought and/or obtained, and
7) copies of results of such examinations or treatment, including but not limited to a doctor's letter, hospital records, etc.,
8) a statement as to what if anything the person is doing to solve the problem, including moving, going to Court, filing public complaints, speaking to local government official(s), etc.

The move information we collect, the better the basis we have to analyze the scope of the problem and to truly be able to document in a more effective manner a category of symptoms we believe exists

Subject: More about your May Rad. Research paper

To: Michael Repacholi, M.D. June 12, 1997
From: Marjorie Lundquist, Ph.D.

Thank you for clarifying the issue of the SPF status of the mice. I had not been aware of that from the discussion of the paper that has occurred, and almost missed it in reading the paper!

I believe the first such laboratory study was the one headed by Arthur W. Guy, sponsored by the U.S. Air Force, which was done in the early 1980s on rats. The SPF status of these rats was the subject of much debate at the time, with some people saying the data on these animals would be difficult to extrapolate to human beings. Of course, that was before the results showed a higher whole-body incidence of tumors!

There is another question about your experiment I would appreciate your clarifying. In the formula you gave for calculating where the boundary between the near and far field lies, what did D represent in your set-up?

I know that D in this formula is supposed to be the largest linear dimension of the transmitter. If a microwave horn had been used, D would have been the diameter of a circular horn, or the diagonal of a rectangular one. You used a monople antenna; was D the length of this antenna? And if so, was it the doubled length (including the reflection in the conductive plate)?

It is my impression that your results in this experiment were unexpected. I certainly would not have expected such results if the signal transmitted by the antenna had been an analog signal.

As the signal in your experiment was a pulsed signal, a Fourier decomposition of the waveform would show a wide range of frequencies present. So this experiment was not really an experiment on a single frequency; it was an experiment employing a whole range of different frequencies simultaneously. While your mice were certainly in the far field of 900 MHz and any higher frequencies, there are some lower frequencies present that your mice were NOT in the far field of, I suspect; and these may well have caused the increase in lymphoma risk you observed in this experiment. The only way to investigate this would be to get a mathematician or electrical engineer involved to do a Fourier decomposition of the waveform you applied to your transmitter in this experiment; then you can see what frequencies were actually present in your experiment, and at what strength, and you can determine for which frequencies your mice were NOT in the far field in this experiment!

It was a good experiment. What are you planning to do next? -- Marjorie

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To: /mail/ma/marjorie Msg #: 2872 Size: 4425/88
From: repacholim@who.ch On: 06/13/97 08:54
Header: 155/1
Subject: Re: More about your May Rad. Research paper
Cc: Ken_Joyner-C20471@email.mot.com

Dear Marjorie

I have copied your message to Dr Ken Joyner who constructed the exposure facility and did the modelling of mouse exposure. He will be able to respond to your questions in more detail.

The antenna was a 1/4 wave monopole acting as a 1/2 wave antenna on the ground plane, so D was the length of this antenna = 16.5 cm. Using the formula for distance to the far field, you obtain the far field distance as 16.5 cm. Since the mice were at 65-70 cm, they were well into the far field.

Regarding the harmonics from a 1/4 wave monopole antenna, you will have to ask Ken. However, even with a maximum SAR of 4.2 W/kg, the heating contribution will be much less than the basal metabolic rate for mice (5-7 W/kg). In anycase the mice were exposed for 2x30 min sessions per day. The likelyhood of them being in the precise orientation to the E-field at the time of irradiation is remote, so their average SAR will be significantly less than 4.2 W/kg.

Hope this helps.

I will be interested in hearing what Ken has to say about harmonics from the antenna, as I thought it was a relatively pure frequency irradiator.

Kind regards
Mike

Subject: Near/far field calculations for various waveforms

To: Michael Repacholi, M.D. June 15, 1997
cc: Dr. Ken Joyner (Ken_Joyner-C20471@email.mot.com)
From: Marjorie Lundquist, Ph.D.

I assume that Dr. Ken Joyner is fairly knowledgeable about electronics, and that this is the reason you referred my earlier message to him. If this is the case, you might want to ask Dr. Joyner to explain how a periodic waveform that is not sinusoidal in shape can nevertheless be expressed as a sum of sinusoidal waves of different frequency and phase (with their amplitudes appropriately weighted): Fourier decomposition.

I certainly did not mean to imply that the equipment you used was generating anything other than a relatively pure frequency of 900 MHz. The pulsed character of the signal is what produces the other frequencies that are present.

If your experiment had irradiated the mice with an unmodulated, uninterrupted signal of 900 MHz, then the formula you applied would have shown that the mice were, unarguably, in the far field, because a half an hour of such irradiation would have been, for all practical purposes, exposure to a pure 900 MHz signal. (In other words, the other frequencies that would be present would be quite insignificant in comparison to the 900 MHz frequency, so one could safely ignore them.)

When this signal is turned on and off rapidly, though, the resulting waveform has other frequencies implicitly present. (The Fourier decomposition will make this explicit.) With the mice essentially being irradiated with a variety of different frequencies simultaneously, one can no longer make a blanket statement about whether they are in the near or far field with only one calculation; a different calculation needs to be made (in principle) for each different frequency! And it is then possible for the mice to be in the far field with respect to some frequencies, but in the near field with respect to others, all at the same time!

If this is confusing, there is an alternative way of analyzing the situation that does not involve Fourier decomposition of the waveform. But it does require recognition of the fact that the formula you used (or any variant of it for other types of antennas) applies ONLY to a sinusoidal waveform. This may not be obvious, so let me elaborate.

Any periodic waveform has a "period": the length of time required to go through one complete cycle. However, a waveform has a unique wavelength ONLY if it is sinusoidal in shape because only then does it have a unique frequency.

The equation you applied -- 2DD/(lambda) -- contains the wavelength lambda. So this equation cannot be applied unless a wavelength can be defined for the waveform.

If you apply an uninterrupted, unmodulated 900-MHz signal to the antenna in your experiment, then you have a sinusoidal waveform for which a wavelength is defined, and you can apply this formula, just as you did in the paper you published--and you will find that the mice are in the far field of the transmitter, just as you claimed in your published paper.

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Now suppose you pulse this signal, as you did in your experiment. Over the half-hour period that the mice were exposed during each 12-hour period, this signal is NOT sinusoidal! It has a different waveform from the sinusoidal waveform that the mice would have been exposed to, had the signal NOT been pulsed.

The pulsed signal is NOT sinusoidal, so it has NO unique wavelength and therefore it is impossible to apply the equation to it to test whether the mice are in the near or far field (because this equation requires a unique value of lambda, which now does not exist for the waveform being used).

In other words, the question--Were the mice in the near or the far field of the transmitter when it was excited by a pulsed signal?--is meaningless. The concepts of near and far field have meaning only for a transmitter that is being excited by a SINUSOIDAL signal! When you pulsed your sinusoidal signal from the signal generator before delivering it to the transmitter, you destroyed its sinusoidal character!

As I say, this is an alternative way of looking at the situation. Most of us find the concepts of near and far field so useful that we don't want to have to abandon them; thus we fall back on the representation of non-sinusoidal waveforms as a weighted sum of sinusoidal waveforms. We then have a unique wavelength for each sinusoidal component, and now can make the near/far field calculation for each sinusoidal component. (But this means we are now relying on the Fourier decomposition of the pulsed non-sinusoidal waveform into its sinusoidal components!)

And what we get, as I have already pointed out, is a "mixed" situation: the mice are in the far field of a great many of the components, but in the near field of some (and right on the borderline of a few).

You need to understand these things, if you are ever going to appreciate why pulsing a signal has such an enormous biological effect in certain situations--situations that are commonly encountered in the laboratory, and also are encountered by people who are close to transmitters, such as people who are using cellular telephones.

Your published statement: "All exposures of the mice therefore occurred in the far field" is, strictly speaking, not really true. The caclulation you made shows that what you were thinking was: "If these mice had been exposed to the unpulsed, unmodulated 900 MHz signal from this generator, their exposures would all have occurred in the far field." That would have been a completely true statement. And for anyone interested in comparing the biological effects of pulsed and unpulsed signals, it would have been a useful statement, as well.

I am taking the liberty of copying Dr. Ken Joyner on this message. Why don't you see what he has to say about it? -- Marjorie

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To: /mail/ma/marjorie Msg #: 2878 Size: 6817/131
From: repacholim@who.ch On: 06/16/97 08:25
Header: 189/1
Subject: Re: Near/far field calculations for various wavef
Cc: Ken_Joyner-C20471@email.mot.com, kjoyner@vtrlmel1.trl.oz.au

Dear Marjorie

Thank you for the explaination about our experimental situation. However, while I understand what you have said, I am not sure whether you feel that the mice were exposed in the near or far field.

Perhaps Ken Joyner could add to this discussion.

Kind regards
Mike

PS Ken, please provide your input.

To: /mail/ma/marjorie Msg #: 2877 Size: 8024/147
From: ken_joyner-c20471@email.mot.com (Ken Joyner-C20471) On: 06/16/97 16:01
Header: 206/1
Subject: Re: Near/far field calculations for various wavef
To: marjorie@omnifest.uwm.edu, repacholim@who.ch

Dear Dr Lundquist,

Thank you for your inquiries about the physics and engineering aspects of the transgenic mouse study. Dr Repacholi has already explained that although the antenna was a quarter wave it must be treated as a half wave antenna because of the image below the ground plane.

On the other issue of the wave form I believe we have a difference of opinion and I trust I have understood your email correctly. Firstly the carrier frequency was indeed a 900MHz sinusoidal wave form that was active for 0.6 milliseconds, 217 times every second for each of two periods of 30 minutes. The period (1/freq.) of a 900MHz wave is 1.1 nanoseconds which means there are some 540,000 cycles of pure 900MHz carrier during each period of 0.6 milliseconds. The use of the 2D.D/lambda formula is indeed valid. There are low frequency components related to the pulse frequency of 217 Hz but their magnitude is very low compared to the amplitude of the 900MHz carrier.

It must be recognised that the aim of the experiment was to determine whether long-term exposure to pulse modulated RF fields similar to those used in digital mobile telecommunications would increase the incidence of lymphoma in transgenic mice. To this end the signal characteristics were selected to mimic that used by the digital network but it was a whole-body, far-field exposure as far as the mice were concerned.

Yours sincerely,

Ken Joyner

Subject: Fourier decomposition--again!
To: Michael Repacholi, M.D. June 17, 1997
From: Marjorie Lundquist, Ph.D.

Below is a copy of a message I have sent to Dr. Ken Joyner. I realize there is little chance of interesting you in actually carrying out the experiment I propose--funding would be difficult to come by, for one thing, and your heart would not be in it, for another--but it ought to be done, because the results will stun a great many people. (They will also explain the results of the experiment you just published, which I am sure were unexpected.) What CAN be done at this time is to generate the Fourier decomposition of the waveform you used, over the important frequencies. Ideally, it should be done with high-quality instrumentation from the very equipment you employed in your experiment. I hope you and Dr. Joyner will give this some thought. -- Marjorie

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To: Dr. Ken Joyner June 17, 1997
cc: Michael Repacholi, M.D. (repacholim@who.ch)
From: Marjorie Lundquist, Ph.D.

Thank you for your comments. Dr. Repacholi referred to you simply as "Dr. Ken Joyner" so I don't know whether you hold the M.D. or the Ph.D. --and if the latter, in what field. As for myself, I am an industrial hygienist with a Ph.D. in physics, and I have begun to specialize in the field of bioelectromagnetic hygiene (preventing diseases caused by exposure to non-ionizing electromagnetic fields).

I think you are correct in your evaluation: we have a difference of opinion. As I understand your position, you feel that it is safe to ignore the low-frequency components present in the pulse, because their magnitude (amplitude) is so very much lower than the amplitude of the 900 MHz frequency that they can safely be ignored, in comparison with the 900 MHz frequency component.

I think that you are assuming the truth of something that needs to be tested experimentally! I don't doubt that the low-frequency components have a far lower amplitude than the 900 MHz component. But health effects such as cancer are reported to occur only at very LOW field intensities, so the "low-amplitude argument" you are using as a basis for arguing against the importance of these low frequencies is actually (from my perspective) evidence IN FAVOR of possibly producing an increase in cancer incidence, not evidence AGAINST this possibility!

An important question, in my view, is to quantitate these amplitudes. That is why I wish you had published--or would publish in future--a Fourier analysis of the signal that was applied to the mice in this experiment. (The region of interest is the low-frequency side of 900 MHz; and I can do some calculations to tell you how low down the spectrum this analysis should go.)

Then, if an experimental test could be arranged, I would provide the frequency to use (continuous exposure, not pulsed) and--if Dr. Repacholi could repeat his experiment with exactly the same experimental set-up, except that the mice were exposed to a continuous signal at the frequency I specified and at the amplitude of that frequency that the Fourier analysis I am hoping you will do shows these mice were exposed to in the just-published experiment on pulsed 900 MHz radiation --I think the results would almost perfectly reproduce the results that were published in the May 1997 issue of Radiation Research by Dr. Repacholi!

It seems to me that this experiment would be well worth doing, since it would test a prediction. (Prediction in matters of this kind is not commonly encountered; at least, not TESTABLE predictions.)

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What I would expect, if such an experiment were actually performed, is that, by exposing the animals to the low-frequency portion of the Fourier-decomposed spectrum, but without the higher frequencies present, the cancer incidence of the test mice would be almost exactly reproduced! (The incidence of lymphoma in the test animals might be slightly smaller than that in the already-published experiment, because the 900 MHz portion of the spectrum would be absent.) But this would show that the lower frequencies you are so sure can safely be ignored are actually contributing almost 100% to the increased lymphoma incidence, while the 900 MHz signal that you and Dr. Repacholi are so sure is all-important in the pulsed exposure is actually contributing almost nothing!

Clearly, if my view turned out to be in accord with the experimental results, it would be a significant finding!

When two people have radically different ideas as to how an experiment would turn out, they try to test it experimentally, if they are scientists.

Dr. Repacholi may have no interest in performing such an experiment, of course--which is why it is so important that the Fourier decomposition of the signal used in his experiment be published! Then some other person would be able to carry out the experiment I have proposed, without first taking the time to repeat exactly what Dr. Repacholi has done.

I do have one other question. It concerns the formula 2D.D/lambda. I have seen various versions of such equations, but (so far as I can recall) not this one. I should like to see a derivation of it. Can you give me a reference (a citation to the literature) for this particular equation? I need to study it before I would feel comfortable using it. -- Marjorie

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To: /mail/ma/marjorie Msg #: 2889 Size: 5668/103
From: ken_joyner-c20471@email.mot.com (Ken Joyner-C20471) On: 06/18/97 17:58
Header: 163/1
Subject: Re: Fourier decomposition--again!
Cc: repacholim@who.ch

Dear Dr Lundquist,

I think we shall have to agree that we disagree. I can only reiterate that the signalling regime used did as near as possible mimic that used in a digital phone. In any follow up studies one could investigate the harmonic content as you suggest however I have no idea if any verification/confirmation studies will be undertaken.

AS far as the formula is concerned there are two texts I can recommend to begin with:

Antennas by Klaus
Antenna Engineering Handbook edited by Johnson and Jasik.

Best regards,

Ken Joyner

To: Dr. Ken Joyner
cc: Michael Repacholi, M.D.
From: Marjorie Lundquist, Ph.D.

July 6, 1997

Subject: The far field boundary equation

I have been studying the equation you used as the boundary for the far field. I didn't find a book titled "Antennas" by Klaus, but I did find a good one by John D. Kraus (a professor of electircal engineering) and it contained the formula. However, it did not provide a derivation of it. I launched a search and finally found the information I was seeking in two books:

Microwave Antenna Theory and Design [Chapter 6; also pages 561; 574-575]
Samuel Silver, ed.
Dover reprint of McGraw-Hill Book Co., 1949.

Introduction to Theoretical Physics [pages 315-324]
John C. Slater and Nathaniel H. Frank
McGraw-Hill Book Co., 1933

The formula comes from an optical treatment of an illuminated aperture. The discussion is thorough and I am now satisfied that the formula is a valid one for microwave antennas.

However, in the derivation of this formula it is assumed that the size of the aperture is at least several wavelengths; that is, the ratio

$$D/(\lambda) > 2.$$

This condition is NOT met by the antenna used in Dr. Repacholi's experiment, where $d/(\lambda) = 1/2$.

The use made of this formula by electrical engineers is in measuring the patterns of antennas. The measuring antenna must be in the far field of the antenna whose pattern is being measured.

I quote from Silver, page 561:

"For small [D] of the order of a wavelength, this requirement may be open to question, and one should in this case have a feed-to-pickup separation of at least several wavelengths."

In other words, the distance given by the formula

$$R = 2\ D \times D/(\lambda)$$

may not be great enough when D and lambda are of the same order of magnitude. I think this caveat applies to Dr. Repacholi's experiment.

I have looked to see whether there is any formula for the far field boundary applicable to the half-wave dipole antenna, and so far have not found one.

If the caveat I have quoted is indeed applicable, and if one considers that $R = 2x(\lambda)$, then--because the wavelength lambda for 900 MHz is 33.3 cm--by my calculation, the mice in Dr. Repacholi's experiment were right on the boundary of the far field! (If "several" means "more than 2" then the mice were not in the far field!)

— CONTINUED —

It is not at all clear to me just what equation ought to be used to define the boundary of the far field under the conditons of Dr. Repacholi's experiment. In my mind, therefore, there is a question as to whether the mice were deep in the far field of the antenna, or on the inner boundary of it.

This is a point that requires clarification, I think, since it plays an important role in the interpretation placed on the experimental results.

In the process of my study of this matter, I became aware that there is a serious qualitative difference between the formula for the far field boundary for an elemental dipole, which I have been studying, and that for an antenna of finite size. The former gives an equation in which R is proportional to lambda, while the latter--the formula you used--has R inversely proportional to lambda. This is quite a difference!

My belief that the frequencies below 900 MHz were the important ones in the Fourier decomposition of your signal was based on the equation applicable to the elemental dipole. I am now satisfied that it is the higher frequencies in the Fourier decomposition that are responsible (which makes much better sense). So I have learned something from my investigation of this issue.

We may still disagree on whether frequencies other than 900 MHz are important, but I am much more comfortable saying that frequencies above 900 MHz are responsible, than saying that frequencies below 900 MHz caused the increase in lymphoma incidence in Dr. Repacholi's mouse experiment!

By the way, your thinking that low intensity equals low health risk is correct for thermal hazards, but cancer is a nonthermal health hazard. And for nonthermal health hazards, at the intensities of interest to us, the higher intensities pose a lower health risk than do the lower intensities! I think you have failed to recognize this, and are applying "thermal thinking" to a nonthermal problem--which is inappropriate!

I appreciate your help with the far field boundary formula. -- Marjorie

To: /mail/ma/marjorie Msg #: 2989 Size: 5101/114
From: repacholim@who.ch On: 07/07/97 09:00
Header: 279/1
Subject: Re: More about the far field boundary equation
Cc: Ken_Joyner-C20471@email.mot.com, harris@wehi.edu.au, kfoster@eniac.seas.upenn.edu, wfp@ee.wustl.edu, martino@iss.it, ts_tenforde@pnl.gov

Dear Marjorie

I appreciate the effort you have gone to to determine if the mice were exposed in the near or far field. I have passed on your thesis to others with more expertise in the field for their reaction and will keep you informed.

Kind regards
Mike

Dear Tom, Ken, William and Martino
PS Any comments?

To: /mail/ma/marjorie Msg #: 2991 Size: 6329/143
From: ken_joyner-c20471@email.mot.com (Ken Joyner-C20471) On: 07/07/97 22:06
Header: 322/2
Subject: Re[2]: More about the far field boundary equation
To: marjorie@omnifest.uwm.edu, repacholim@who.ch
Cc: harris@wehi.edu.au, kfoster@eniac.seas.upenn.edu, wfp@ee.wustl.edu, martino@iss.it, ts_tenforde@pnl.gov

All,

I have sent the attached explanation to Dr Alan Harris previously and I believe it is an appropriate explanation in this instance.

Mike, I am on leave until 11 July.

Best regards,

Ken Joyner

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Several standards discuss this issue and the commonly accepted breakpoint between the near and far field is wavelength/2pi. For practical purposes a distance of half wavelength is used. The Australian Standard states the distance from the antenna for far-field conditions is the greater of 2D2/wavelength or half wavelength. For a half-wave dipole such as used in the experiment the two distances are the same. Certainly at a distance of two wavelengths the radiating or far-field characteristics are well established. The distance of 65cm is very close to two wavelengths. No matter which way you wish to view the exposure set-up it was a far-field exposure.

To: /mail/ma/marjorie Msg #: 2998 Size: 2929/55
From: repacholim@who.ch On: 07/08/97 10:26
Subject: Re: Boundary of far field for half-wave antenna

Dr Joyner is on holidays at present Marjorie. He is a PhD physicist who was head of the Telstra Research Labs in Melbourne. His speciality is calibration and design of RF equipment. He has the best antenna design group in Australia. His qualifications are beyond reproach. However, he should be able to defend the premise on which he based his calculations for the far field.

You saw what William Pickard had to say. He is an excellent electrical engineer.

Kind regards
Mike

Subject: Another question!

To: Dr. Ken Joyner July 7, 1997
cc: Michael Repacholi, M.D.
From: Marjorie Lundquist, Ph.D.

Dr. Joyner, in your first message to me on July 7th, you wrote: "In the Repacholi experiment it is the far-field components which are predominant and the near-field components are around 10% of the total field." Can you tell me what the basis for this statement is?
It gives me the impression that you actually measured the fields around the antenna used in the Repacholi experiment. Do you have actual measurements of the electric and magnetic fields around that antenna, made under the conditions used in the experiment? If so, are you planning to publish them? -- Marjorie

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To: /mail/ma/marjorie Msg #: 2990 Size: 6025/127
From: ken_joyner-c20471@email.mot.com (Ken Joyner-C20471) On: 07/07/97 22:12
Subject: Re: More about the far field boundary equation

Marjorie,

Thank you for your interest in this subject.

The issue of near versus far-field is complex but what you have to consider is which components predominate at a distance from an antenna. In the Repacholi experiment it is the far-field components which are predominant and the near-field components are around 10% of the total field. I have used the following explanation previously.

Best regards,

Ken Joyner

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Several standards discuss this issue and the commonly accepted breakpoint between the near and far field is wavelength/2pi. For practical purposes a distance of half wavelength is used. The Australian Standard states the distance from the antenna for far-field conditions is the greater of 2D2/wavelength or half wavelength. For a half-wave dipole such as used in the experiment the two distances are the same. Certainly at a distance of two wavelengths the radiating or far-field characteristics are well established. The distance of 65cm is very close to two wavelengths. No matter which way you wish to view the exposure set-up it was a far-field exposure.

Subject: Yet another question!

To: Dr. Ken Joyner July 7, 1997
cc: Michael Repacholi, M.D.
From: Marjorie Lundquist, Ph.D.

In your first e-mail message to me on July 7th you wrote: " . . . the near-field components are around 10% of the total field." What field are you referring to: the electric field, the magnetic field, or the Poynting vector field? And how is the "percentage near-field" calculated? (I am seeking an operational definition.) -- Marjorie

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To: /mail/ma/marjorie Msg #: 2999 Size: 1712/39
From: ken_joyner-c20471@email.mot.com (Ken Joyner-C20471) On: 07/08/97 22:5
Subject: Re: Another question!

Marjorie,

The figure of 10% is based on calculations and I will send you the details when I return from leave on 14 July. We did measure the electric fields but not the magnetic fields and we used both an isotropic probe and a half wave dipole. We are not planning to publish any other than the maximum and minimum fields as per the Repacholi paper.

Best regards,

Ken Joyner

Subject: Glad to know you made measurements!

To: Dr. Ken Joyner July 8, 1997
cc: Michael Repacholi, M.D. & William F. Pickard
From: Marjorie Lundquist, Ph.D.

I feel we are on solid ground at last! You made measurements of the electric field around the antenna. (If this was reported in the paper by Repacholi et al., I missed it.)

It will be interesting to see how many different formulas there are for the far field boundary. Right now I am reading King's 1956 book titled *The Theory of Linear Antennas*, at the suggestion of Dr. Pickard. It contains a wealth of information that is new to me.

By the time we get through discussing this issue (which I expect will be within a week) it should be pretty permanently put to rest--unless I discover another "red flag" somewhere! This seems pretty unlikely to me at present.

If you are on holiday, I hope I didn't disrupt your vacation too seriously! -- Marjorie

To: /mail/ma/marjorie Msg #: 2993 Size: 7314/215
From: wfp@ee.wustl.edu (William F. Pickard) On: 07/07/97 19:22
Header: 412/2
Subject: Re: More about the far field boundary equation
To: marjorie@omnifest.uwm.edu, repacholim@who.ch
Cc: Ken_Joyner-C20471@email.mot.com, harris@wehi.edu.au, kfoster@eniac.seas.upenn.edu, wfp@ee.wustl.edu, martino@iss.it, ts_tenforde@pnl.gov, EMS029%email.mot.com Helen_Buskirk-EHB001C@email.mot.com

My views are different still.

First, operationally, "far field region" is taken by engineers to mean that region which is far enough from the antenna for the angular field distribution to be (to good approximation) that at infinity. This is the definition adopted for example in IEEE Standard C95.1-1995.

The boundary of this region depends a lot on the TYPE of antenna used. In the Repacholi experiment, it was a quarter-wave monopole converted into a half-wave dipole by the ground plane.

Let H be the length of a monopole perpendicular to its ground plane and R the distance from the base of the antenna to an irradiated object. A simpler question which could be asked can now be seen to be: "How big must R become before the power density is falling off as 1/R=B2 ?" Let us focus firmly upon the well-studied case H=3DL/4 , where L is the wavelength (here 0.33 m).

The answer to even this restricted problem is complicated, but the formula I go by is that offered by R.W.P. King in his "Theory of Linear Antennas" (on pg 529): R/H > 5 . Even on pg 529, the analyses are still only approximate; but King lays everything out in detail, and the fact that we're worried only about angularly close to the ground plane strongly reinforces the above conclusion. The take home message I receive from the King analysis is that the relative sizes of R and L greatly influence the current on the antenna and details of the angular variation of the fields; but what counts near the ground plane is R/H , especially at H=3DL/4 .

In the Repacholi system, R/H =3D 7.9 , a seemingly comfortable margin of design.

I've seen Ken Joyner's response. It will be interesting to see others.

William Pickard

Subject: Far field boundary equation

To: William F. Pickard July 7, 1997
cc: Michael Repacholi, M.D. & Dr. Ken Joyner
From: Marjorie Lundquist, Ph.D.

Thanks very much for the King reference. I'll look for a copy of his book.
Not being an electrical engineer, I profess no expertise on this question. But I can recognize a "red flag" when I come across one!
Unless it turns out that Dr. Joyner has actually measured the fields that surround the antenna in question, I probably won't be convinced unless I either caclulate the fields myself (which is apparently quite difficult to do) or else can find a thorough discussion of the matter by someone else who has carried out the necessary computations.
When a host of different opinions exist on a given question of fact, it is usually a sign that the answer is not known for certain! -- Marjorie

To: /mail/ma/marjorie Msg #: 2994 Size: 2420/57
From: wfp@ee.wustl.edu (William F. Pickard) On: 07/07/97 20:16
Subject: Re: Far field boundary equation

When a host of different opinions exist, it may be that the problem has not been posed properly. The equation in the Repacholi paper was I believe intended as a rule of thumb for engineers. I mean, asking for a single mathematically rigorous rule for all different kinds of antennas is like asking for a single cure for diabetes.

To really confuse you, there is another commonly used rule of thumb for the far field: 2=D73.14159=D7R/L>>1 . The Repacholi case gives 12.4, again an answer with a comfortable design margin.

You seem interested solely in the antenna of the Repacholi experiment. That is why I suggested the King formula: because it was designed with this specific sort of situation in mind. For the Repacholi case, I'd bet that virtually every antenna engineer on planet Earth would decide that 0.65 m is far field.

But by all means get a second opinion. R.W.P. King himself is still active and can be reached at Harvard. The number is (617)495-4468. If he's away, his secretary can probably suggest one of his former graduate students: many are now Fellows of the Institute of Electrical and Electronics Engineers.

William Pickard

Subject: My interest in far-field boundary equation
To: William F. Pickard July 7, 1997
From: Marjorie Lundquist

My immediate interest is in evaluating the conditions of the Repacholi experiment, yes. But the question of where the boundary of the far field lies--not to mention what criteria should be applied in making decision! --for ANY antenna is of interest to me, too. So I think it is fair to say that my interest is general as well as specific.
You are quite right about the possibility that the true problem is failure to pose the question properly. Failure to pose a scientific question properly is, I suspect, the source of an enormous waste of time, talent and money in our society. (I have a specific issue I mind when I say that; I suspect an accurate estimate of the costs incurred of failure to pose the problem properly in that instance may well have totalled over a billion dollars in 2 decades, just in the USA alone. I could probably find some more if I tried; indeed, I believe I have just thought of one, the costs of which could turn out to be so high that they could bankrupt an entire country! Both of these problems are, more or less, of an electrical engineering nature, too.) -- Marjorie
P.S. Are you at Washington University in St. Louis?

To: /mail/ma/marjorie Msg #: 3002 Size: 1561/45
From: wfp@ee.wustl.edu (William F. Pickard) On: 07/08/97 15:58
Subject: Re: My interest in far-field boundary equation

Yes. Washington University in Saint Louis.
William Pickard

Subject: Sent to Dr. William Pickard July 8, 1997

Subject: Thanks!
Dr. Pickard, I have the King book and am beginning to study it. Thanks very much for the reference.
By the way, you seem to think that I want to find that the mice in Dr. Repacholi's experiment were in the near field. Not so. I am playing "devil's advocate" in this. My personal preference is that they be in the far field. I am exploring the possibility that they may NOT be in the far field very carefully, because a question has been raised in my mind about this point, and I want to be very, very sure that no error has been made about which part of the antenna field they were in.
I'm glad to have my "decoding" of your e-mail address confirmed as accurate! -- Marjorie
cc: Michael Repacholi, M.D. & Dr. Ken Joyner

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**********

Subject: Sent to Dr. William Pickard July 8, 1997

Subject: Question about effect of angle
Dr. Pickard, in your message to me of July 7th, you wrote: " . . . and the fact that we're worried about angularly close to the ground plane strongly reinforces the above conclusion." (I understand you to have meant "we're worried about angularity close . . ." and that this means "we're worried about whether we are far enough away from the antenna to consider that the Poynting vector field consists of vectors that are parallel to one another, when we are in the equatorial plane of a half-wave dipole antenna".)
This raises the question in my mind, as to what would happen if we were NOT in the equatorial plane of a half-wave dipole antenna, but well out of its equatorial plane? [This question has nothing whatever to do with Repacholi's experiment; I'm just curious.] Could you discuss this a bit?
-- Marjorie

To: /mail/ma/marjorie Msg #: 3038 Size: 1438/39
From: wfp@ee.wustl.edu (William F. Pickard) On: 07/10/97 14:35
Subject: Re: Question about effect of angle

A good example of what happens far from the equatorial plane is the null in the far field along the axis of the linear antenna. But the near field does not have a null. Figure 8.4 in King sort of shows this, if you already know what you're looking for. To go deeper would require asymptotically expanding the mathematical forms of the several field components.

William

Subject: Sent to Dr. William Pickard July 10, 1997

Subject: Thanks--and another question!
Dr. Pickard, thank you for your comments about the angle effect, and the reference to the King figure.
I have been wondering whether there exists a compendium of the various equations for the boundary of the far field, and the types of antennas to which each applies, with discussion of their limits of applicability. If no such document exists, then I think I'd like to suggest to Dr. King that he consider preparing such a document. He may be unwilling to do so at his advanced age, but it would be a shame not to try to tap the wealth of information he must have amassed over the years--not to mention his deep familiarity with antennas!
Any comments?
By the way, I am beginning to doubt that we are going to hear much from anyone else on this issue (unless they are all on vacation). I do thank you for your response. -- Marjorie
cc: Michael Repacholi, M.D, & Ken Joyner

To: /mail/ma/marjorie Msg #: 3039 Size: 1244/39
From: wfp@ee.wustl.edu (William F. Pickard) On: 07/10/97 17:55
Subject: Re: Thanks--and another question!

If I knew of such a compendium, I'd have suggested it long since. I rather doubt that one exists; but I never made a search.
William Pickard